REMARKS/ARGUMENTS

Claims 13, 20, and 64-66 are amended by this response. No claims have been canceled. Claims 2-8, 10-11, 13-22, and 62-74 remain pending.

Embodiments of systems in accordance with the present invention may be used to form low k dielectric materials during the fabrication of semiconductor devices. In particular, the low k dielectric material may comprise a mesoporous oxide film formed by spinning a mixture of solvent, liquid precursor, and surfactant over a workpiece.

The surfactant ensures effective dispersion of the silicon/oxygen compounds in the solution for even film content deposition on the substrate. (Page 41, lines 4-7). Once the solvent/liquid precursor/surfactant mixture has been spun onto the workpiece, it is solidified by curing. (Page 41, line 24 - page 42, line 3).

Stripping the surfactant from the solidified layer forms the mesoporous oxide film. In one embodiment, the surfactant is stripped by exposing the solidified layer to an oxidizing ambient in the form of an oxygen plasma at low pressure:

> [a]s the surfactants are removed from the film, <u>pores are formed as the silicon/oxygen component of the assemblies retain the shape of the oxide film, preferably a cubic phase structure, and harden to form a mesoporous</u> film. (Emphasis added; page 42, lines 12-15).

The resulting mesoporous oxide film is susceptible to moisture absorption, which can degrade its favorable dielectric properties. In order to protect the mesoporous oxide film, it may subsequently be capped with an oxide layer deposited at low pressures. (See page 3, lines 17-27).

The mesoporous oxide and capping layers have conventionally been formed using different tools. However, transferring the wafer bearing the uncapped mesoporous oxide film between the different tools can result in contamination of the film by water or other materials. Therefore:

> there remains a need for an integrated atmosphere and vacuum system that can deposit and cap low k dielectric materials with high substrate throughput. Ideally, the integrated system <u>will reduce contamination of deposited materials</u> by eliminating one or more transfers between vacuum cluster tools and atmosphere cluster tools. (Emphasis added; page 5, lines 3-6)

Embodiments of systems of the present invention comprise a single cluster tool having distinct modules for forming the low k dielectric and the capping layers. Specifically, the low k dielectric layer may be created utilizing a first module, and the workpiece may then be transferred through an interface to the second module for forming the capping layer.

The above summary has emphasized the role of stripping chamber in removing surfactant to form the mesoporous oxide layer. However, the surfactant stripping step may also serve to completely remove other contamination remaining in the mesoporous oxide layer following the solidification step:

> The plasma is performed at a pressure of between about 0.5 Torr and about 10 Torr. The oxygen species bombard the film and react with the surfactant <u>and any remaining moisture and solvent</u>, thereby removing those agents from the film. (Emphasis added; page 42, lines 8-11)

The environment of the stripping chamber is relatively "dirty", containing unreacted gas species, reactive ionic species, and the byproducts of surfactant, solvent, and moisture removed from the deposited layer. The reactants or reactant by-products of the stripping process can undesirably contaminate the wafer during subsequent formation of the highly pure capping layer under precisely controlled low pressure conditions.

In order to minimize the possibility of such contamination, certain embodiments in accordance with the present invention position the surfactant stripping chamber in the first module, outside of the carefully controlled low vacuum environment of the second module:

> The high pressure deposition module is preferably a <u>staged atmosphere</u> system which generally includes a housing containing one or more substrate spinner chambers, one or more substrate curing chambers, <u>one or more substrate stripping chambers</u> (or one or more annealing chambers) <u>which may be evacuated to near vacuum conditions</u> and are compatible with oxygen and/or ozone atmospheres and oxygen containing plasmas . . . . (Emphasis added; page 6, lines 15-19)

The high pressure deposition module may be referred to as a "staged atmosphere" system because it includes chambers operating at or near atmospheric pressure, as well as the evacuable substrate stripping chambers operating at low pressures.

Pending independent claims 64 and 66 have now been amended to specifically cover embodiments where a stripping chamber is located in the first module:

> 64. An apparatus for processing substrates, the apparatus comprising:
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> a staged high pressure processing module including a first plurality substrate processing chambers, a first transfer chamber that enables access to each of the first plurality of substrate processing chambers, and a first substrate handling member disposed in the first transfer chamber and configured to transfer substrates into and out of any of said first plurality of substrate processing chambers; wherein each of the first plurality of substrate processing chambers is dedicated to perform at least one step associated with the formation of a porous dielectric film from a liquid precursor including at least one liquid precursor deposition chamber, and one or more substrate stripping chambers, the one or more stripping chambers in communication with a vacuum system and configured to be evacuated to near vacuum conditions . . . .
>
> 66. An apparatus for processing substrates, the apparatus comprising:
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> a staged high pressure processing module including a first plurality of substrate processing chambers, a first transfer chamber that enables access to each of the first plurality of substrate processing chambers, and a first substrate handling member disposed in the first transfer chamber and configured to transfer substrates into and out of any of said first plurality of substrate processing chambers, said first plurality of substrate processing chambers including one or more substrate stripping chambers, the one or more stripping chambers in communication with a vacuum system and configured to be evacuated to near vacuum conditions . . . .

Claims 2-4, 10-11, 13-16, 20, 22 and 62-67 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. patent no. 5,769,952 to Komino ("the Komino patent") in view of U.S. patent no. 5,858,108 to Hwang ("the Hwang patent"). Claims 5-6 and 17-18 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the Komino and Hwang patents further in view of U.S. patent no. 6,214,620 to Kim ("the Kim patent"). Claims 7-8, 19, and 21 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the Komino and Hwang patents further in view of U.S. patent no. 5,587,038 to Cecchi et al. ("the Cecchi patent"). Finally, claims 68-72 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the Komino and Hwang patents further in view of Japanese P 11-087467A and U.S. patent no. 6,318,945 to Hofmeister ("the Hofmeister patent"). These claim rejections are overcome as follows.

The Komino patent is the seminal reference relied upon by the Examiner to reject the pending claims. The Komino patent describes a cluster tool comprising a first high pressure

module and a second low pressure module. The high pressure module may be utilized to perform wet chemical processing at or near atmospheric pressure. The low pressure module may be utilized to perform chemical vapor deposition.

However, unlike embodiments that are the subject of the pending claims, the first high pressure module disclosed by the Komino patent is not configured to include a stripping chamber evacuable to near vacuum conditions. Specifically, the first high pressure module of the Komino patent operates only at atmospheric pressure or higher:

> [i]n the case of this type of normal pressure treatment unit, although treatment can be performed under the natural atmosphere, a preferred setting is a somewhat higher positive pressure than natural atmosphere. An inert gas such as N_2, CO_2, or Ar gas can be used for setting to a positive pressure, thereby preventing the incursion of impurities and allowing their expulsion. (Emphasis added, col. 6, lines 36-42)

Moreover, unlike the claimed embodiments, the first high pressure module disclosed by the Komino patent is not staged. Specifically, the Komino patent contains no teaching or suggestion that individual chambers of the high pressure module may operate at different pressures. Rather, the Komino patent treats each of the chambers of the high pressure module as operating at a common pressure of atmospheric or greater. (See col. 6, lines 1-3).

The Examiner has combined the Komino patent with a number of other patents in order to provide specific cluster tool structures recited in the former independent and dependent claims. However, none of these references teach or even suggest a cluster tool including a staged atmosphere first module including an evacuable stripping chamber, as is now recited in the independent claims.

In light of the current amendments to the claims, and specifically because the combination of references relied upon by the Examiner fails to teach every element of the pending claims, it is respectfully suggested that the pending obviousness rejections have now been overcome. The pending claims are now in condition for allowance, and early action by the Examiner to this effect is urged.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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